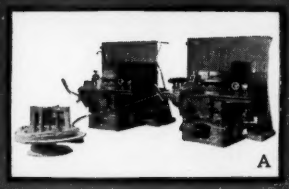
WIRE & WIRE PRODUCTS

VAUGHN MOTOBLOC

(PATENT APPLIED FOR)



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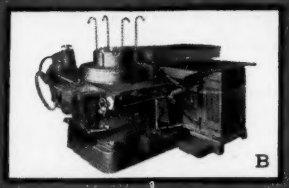

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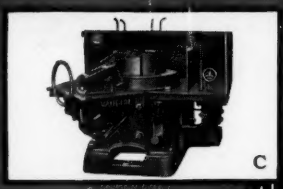

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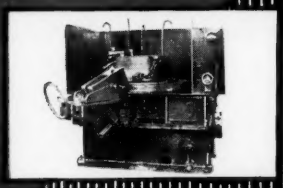

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Illustration "B" shows a No. 13 Motobloc arranged with two die holder brackets for drawing either single or in tandem.

Illustrations "C" and "D" show the standard No. 12 and No. 12-22 Motobloc.

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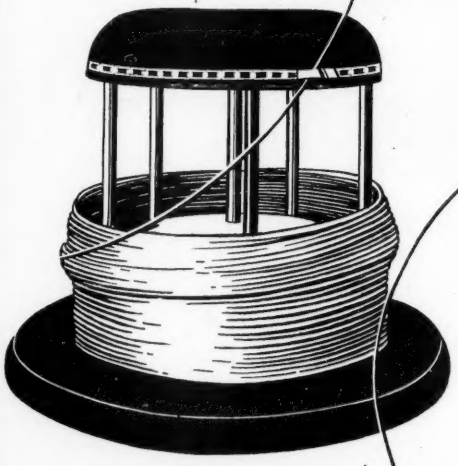

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WIRE & WIRE PRODUCTS

A monthly publication devoted to wire drawing and wire forming

Vol. 3 January, 1928 No. 1

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Editorial Offices:
471 Fourth Ave., New York City, Tel. Ashland 6280
Publication Office, Washington, N. J.
Issued Monthly
50c a Copy
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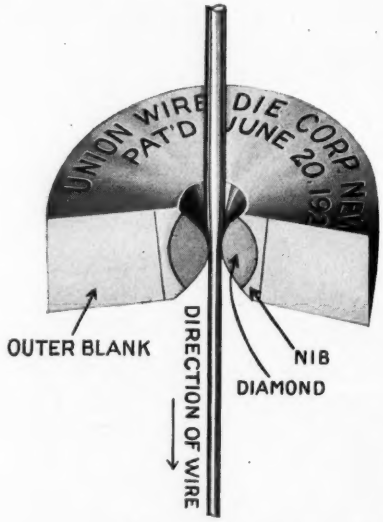


Sectional View of round stone diamond die setting designed to resist drawing strains and the effects of vibration.

UNION WIRE DIE CORP.

250 W. 40th St. ***New York City***

WIRE
& WIRE PRODUCTS

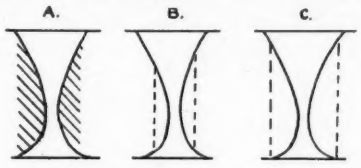
Vol. 3 JANUARY, 1927 No. 1

The Use of Break Down Diamond Dies in Drawing Wire

By M. Simons
(Union Wire Die Corp.)

WHEN a diamond die is unfit for finishing wire, it has generally been accepted that the die is to be pulled up to the next size and used as a breakdown die, and when same is worn out again, it can be pulled up and put into service once more. While fundamentally the idea is right, the operations followed out in the reconstruction of the die, are not, in most of the cases, developed along the proper lines and the dies finished in that method, made bad breakdown dies. True enough, an improperly shaped die will reduce the wire and bring it to a point, where the finishing die will finish the wire. Following up however, we will find a condition which shows that process of drawing wire by use of so-called breakdown dies with only a finishing die to finish wire, is poor.

Primarily the die is drilled, shaped and polished to a certain shape, where the die will draw the wire at a pull of less than 50% of the breaking point of wire. I mean, if it takes 100 pounds to break a certain size of wire, this wire will draw at a pull of between 40 and 50 pounds through a properly shaped and polished die. If the die is shaped improperly, in other words, has a bearing double the proper length, with an improper cone or entrance of the die and is not polished well enough, it will take between 60 and 75 pounds to pull that wire. The wire, however, will be pulled and as it is generally taken, the finishing die will finish the wire. But, upon closer examination, through a miscroscope, we find that a wire that has required from 60 to 75% for the pull, has a broken surface. In other words, the flux of the copper is torn in many places, forming a shredded surface and upon making an elongation test, it is easily found that the wire drawn through a properly shaped and finished die, with a pull of below 50% will stand a better elongation than a wire pulled through an improperly shaped die.



Wear of diamond dies alters the shape as well as the size.

When a die is properly shaped, after sketch A, and is finally pulled up to the next size, the shape follows the dotted line as per sketch B. When same is worn out and recut again, the shape becomes something like dotted line shown on sketch C. It is obvious that a die with a shape as is shown on sketch C, while it might draw wire, it nevertheless, will make bad wire. There is no reason why a worn out die cannot be reshaped, repolished and made into a finishing die, as well, if the diamond is good.

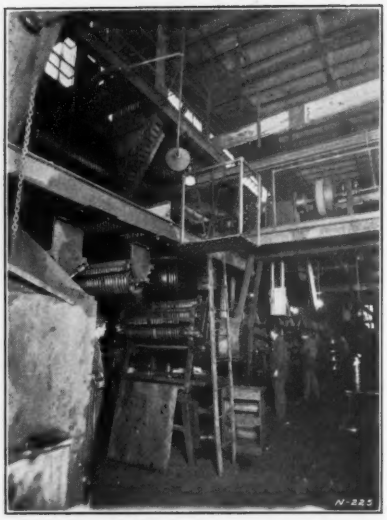
Hence the proof that the wire is being spoiled by the improper shape of the die. It might not be as easily detectable when the wire is drawn down to .020 or .018. It is more noticeable when it is drawn down to .004 or .003, as in that case, the wire produced on bad dies, when it is on the sizes between .054 and .020, will actually begin to break, while drawing down to the very fine sizes. It forms a peculiar break, known in the mill as a cup and cone break, which is directly traceable to the use of bad breakdown dies.

In some instances, even a cracked die is being used as a breakdown die and this is another phase of the wrong application of dies. It might be that the fin left by the crack in the die, is easily smoothened

(*Continued on page* 33)

Continuous and Automatic Gas Heat Treating

By J. B. Nealey



Applying and baking japan to steel strip continuously and automatically.

MASS production was made possible by automatic machines but it was not until automatic heat treating units were perfected that the great possibilities of the mechanicalized era were fully realized. For years inefficient apparatus and uneconomic fuels made heat treating an operation separate and apart. More recently, however, automatic furnaces, performing an almost unlimited range of heating processes, have been synchronized nicely into straight line mechanical production.

Nowhere is there a better example of this than at the Chicago plant of the Acme Steel Company, which is the largest producer of steel box strapping, and a large assortment of steel items used for reinforcing packages. This company is the world's largest maker of electro galvanized strip. It also produces coppered and galvanized stapling wire, flexible steel mats for conveyors, door mats, etc., and complete line of small tools for the application of box strapping and bale bands.

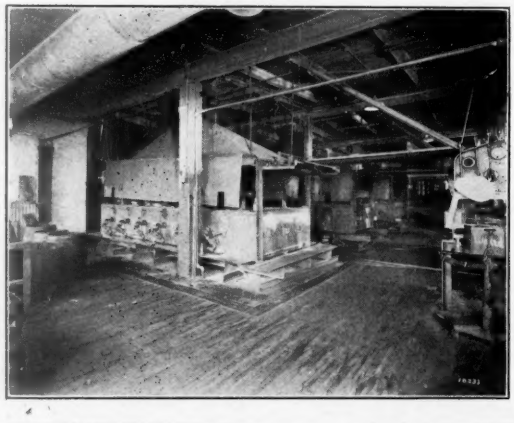
At the Riverdale plant, immediately south of Chicago, the Acme Steel Company operates one of the most modern hot and cold rolling mills in the country, which not only supplies the finishing plant in Chicago, but a large part of the trade, with strip steel. In fact these mills are equipped for large volume production to meet the rapidly increasing demand for a source of supply, capable of producing a full range of sizes in hot and cold rolled strip steel. This plant is served with spur tracks from the Pennsylvania, Illinois Central and Baltimore & Ohio railroads and has nearly a mile of frontage on the Calumet River, directly connecting with the Great Lakes.

The finished products plant in Chicago is thoroughly up-to-date in every respect and is completely equipped with special and standard automatic machinery for manufacturing and finishing the various lines named. This plant covers a city block, contains more than 250,000 square feet of floor space and is served with spur tracks from the Illinois Central and Sante Fe railroads.

When the mill coils are received at the Chicago plant they go to the slitting department. Here a battery of slitting machines cut these coils into ribbons of two to five strands at a time and rewind each.

The next operation is annealing and there are three gas fired furnaces in a row, each 16 feet long and 5 feet wide. In front of each of these units is a reel stand, the material being pulled thru by rolls at the other end of the furnace. The correct annealing temperature is maintained at all times and the heating period is regulated by the speed of the rolls.

As the strands emerge from the discharge end of the annealing furnace, they pass through tanks of pickling fluid, washes, etc., and then over wheels and thru the floor and ceiling to the floor below. Here they are run thru a series of electro-plating tanks, and more washes, and then back thru the ceiling again, to the rewinding machines on the second floor. This is a most excellent example of the exact synchronization of several operations, slitting, heat treating,



Battery of gas furnaces for continuous and automatic annealing of steel strip.

pickling, washing, electroplating, washing and rewinding. This whole process is continuous for as fast as the coils of strip are used up they are followed thru by others.

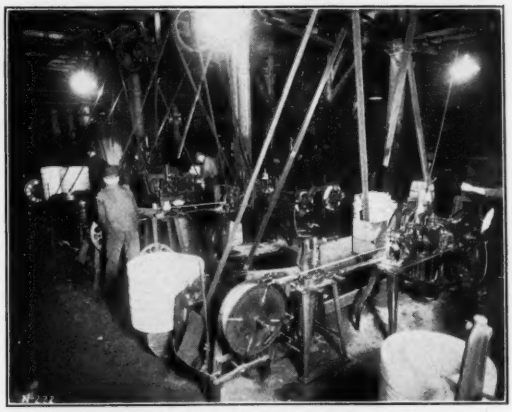
The hot galvanizing operation is very similar to that of electroplating. The strips are first run thru gas-fired annealing furnaces similar to those described and then thru a pickle and wash. After the wash they pass straight thru galvanizing furnaces. These consist of hot zinc kettles, housed in brick structures and hooded to remove the fumes. The zinc is kept molten by gas burners firing in ducts that pass underneath. Each of these furnaces is equipped with 14 burners with single valve control and the metal is kept at the proper heat, at all times, by an automatic temperature control.

The same system has been

View of steel strip warehouse.

adapted for finishing the strands being japanned and the japan baked on, automatically. The strands are first annealed in annealing furnaces and then pass thru tubes to the ceiling and thence across the room and down to the japanning furnaces. These annealing units vary slightly from the others described, in that they are fourteen feet long, four wide and three high and have four gas burners to a side.

The Japanning furnaces are vertical and have a pot of liquid japan in the bottom. The strands pass down thru the heating chamber of the furnace where they are preheated, thru the liquid where they are coated with japan and up thru the furnace again where the japan is baked on. As the strips pass from the furnaces they travel to the ceiling and back down



Box strap manufacturing department.

again on revolving wheels, several times to cool after which they pass into the winding machines and are coiled.

These heat treating units are the last word in economy of labor, economy of fuel, economy of space and the speed of operation and volume of output is unusually high. They are entirely automatic in operation thereby eliminating the usually large error due to the human equation. This assures a product always uniform in quality and the heavy losses due to irregularity in temperature and heating periods has been done away with. While other fuels have been tried it was found that gas was the only one that combined ease of control, efficiency and economy.

Various products are made in different departments in this plant each finally winding up in the shipping room. In one department is located a long line of power presses, equipped with the proper dies and automatic feeds for the manufacture, in quantity, of such articles as barbed box straps, shook ties, buckles, etc., etc.

Box strapping, formed of galvanized strip, is produced in still another department. Here are located machines which turn over both edges of the strip and corrogate or knurl the center all in a single operation. All kinds of special box strappings are made here and are either put up in coils or straightened and cut to length.

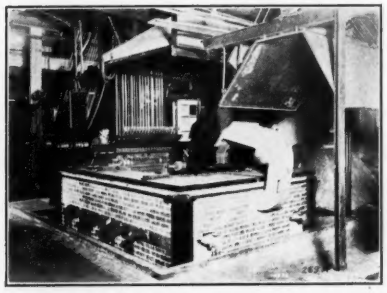
Elsewhere is a battery of machines for making the corrugated wood joint fasteners.

The flexible steel matting is formed in a series of machines, the spindles being formed in one, strung on wires in another and the edges finished in a third. Clasps are formed in a battery of automatics of multiple operation. Wire is fed into these units which flattens, forms, cuts and sharpens points all in a single operation.

These flexible clasps are then annealed in a gas-fired furnace of the continuous type. This unit is five feet long, five wide and four deep, and is heated with two burners on each side. The clasps are placed in boxes which are fed in and pushed thru with a rack and pinion pusher. The correct temperature is maintained and the proper heating period is controlled by regulating the speed of the motor driving the pusher. The work is then plated or cement coated.

A completely equipped and modern machine shop is maintained for the manufacture of the line of small tools for the application of box strapping by customers. These tools are in wide use by shippers throughout the world. They are simple

(*Continued on page 33*)



Galvanizing strip steel continuously and automatically. Kettles fired with gas.

Heat Treatment

British Practice Outlined

By J. D.

Bruntons Research

WHEN a hot-rolled wire rod is received from a rolling mill it, naturally, is not of an even temper throughout its length, because cooling of the inside of the coil is retarded by the outer layers which are chilled by the atmosphere. In order to make the structure of the steel more uniform throughout the piece heat treatment is necessary. Figs. (1) and (2) show respectively the structures of the inside which has cooled slowly and of the outside which has cooled quickly, in a coil as received from the rolling mill. This will show clearly the difference in structure which would, of course, make a material difference to the wire when finished. Moreover, the rod when received from the rolling mill is not, as a rule, perfectly circular and the point end and back end usually vary somewhat in diameter. It is, therefore, usual before heat treatment takes place to clean the rod and put it once or twice through the die so as to make it uniform in section. This is called "ripping." If the heat treatment were performed on the rod as received from the rolling mill it would receive a greater amount of cold work at one end than the other, and a uniform tenacity on the finished wire would not be obtained.

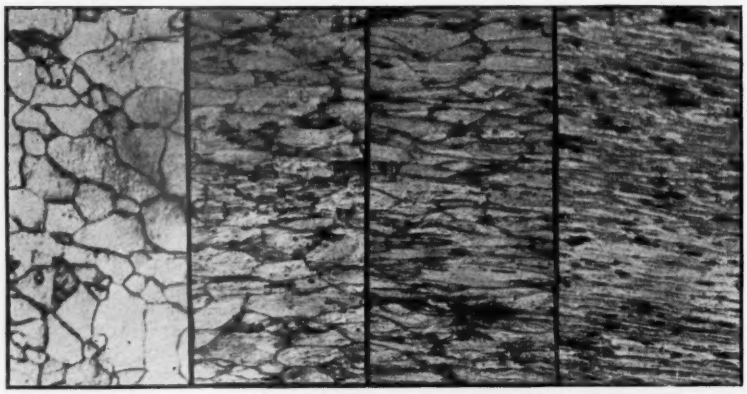
In order to correct these differences of structure, and to get the wire rod into the proper condition for drawing into wire, it has to be annealed, normalised, or "patented." The type of heat-treatment applied depends on the class of steel. Mild steels and certain high carbon steels are simply annealed in such a way as to get them into the softest possible condition. In dealing with a low carbon steel it is usual to anneal the wire in pots. These pots contain two or three cwts of wire, and are heated above the critical range of temperature, viz: to about 850°C.—and then allowed to cool slowly in the pot so that the rate of cooling is uniform throughout the piece. These pots are usually built in batteries. In some cases the pots themselves are taken out and allowed to cool in situ.

In mild steel wire, the object of this annealing is to remove all internal stresses, and to allow the crystals to settle themselves into their most stable position, so that they can be subjected to the greatest amount of drawing before re-annealing.

Annealing above the proper transformation point AC3 is to be recommended in the first instance, to remove all rolling stresses and irregularity in structure due to different rates of cooling; but when the steel has been drawn, and a second annealing is necessary to re-soften the wire so that further cold work may be put on it, it is not always necessary to anneal at a high temperature. Most of the physical effects of drawing are eliminated when a temperature slightly above 500°C. is reached, and annealing at 650°C. makes the steel sufficiently ductile to stand further cold work. There are certain permanent effects on the structure which are not removed by this low temperature annealing, and it is, therefore, occasionally necessary to normalize the material either before or after the final drawing stage.

The heat-treatment of high carbon steel wire depends entirely on the purpose for which the wire is intended. If the object is to make a wire where the finish is soft, so that a tool or some other shaped instrument can be made from it, and the material has to be hardened and tempered after the tool is fashioned, then the heat-treatment is somewhat similar to that employed with mild steels. The temperatures employed are, of course, slightly different, and have to be regulated to suit the carbon content of the steel. In steels above 0.90% carbon, the transformation points converge into one at a temperature slightly above 700°C., and in the preliminary annealing at least, a temperature of 750°C. should be reached. As in the case of mild steels, however, intermediate annealings can take place below the critical range with advantage.

High carbon steels such as this are almost invariably annealed in pots, and special care



Longitudinal section of Steel I, 0.039% C. Fig. 3. Annealed, Fig. 4. Drawn two passes Fig. 5. Drawn four passes Fig. 6. Drawn six passes. (Magnified 250 times.)

# of Steel Wire

by Noted Authority

Brunton

Laboratory, Mussellburgh, Scotland

must be taken to prevent oxidation, otherwise a certain amount of carbon will be burnt out of the steel and a soft skin formed. To prevent this it is necessary to anneal in a non-oxidising atmosphere. Various methods of accomplishing this are in vogue: the atmosphere of the furnace itself may be charged with producer gas; the pots themselves may have a gas seal, or they may be filled with some substance which has a greater affinity for oxygen than the steel.

Wire is annealed with the object of softening it so that it can be easily drawn, but it is not always desirable to soften the wire completely, and when high tensile wire possessing great toughness and flexibility is required a special form of heat-treatment is necessary. This process, which is called "patenting," is really a semi-tempering process, and as such, is therefore not applicable to mild steels, since these do not contain sufficient carbon to take a temper. Wire such as Spring wire, naturally hard; piano wire and rope wire is therefore made out of a steel containing anywhere from 0.45 to 1.00% carbon, and is heat-treated by this process. As is well known, steels containing the requisite amount of carbon can be tempered to various degrees by regulating the rate of cooling through the critical temperature. As a general rule, the practice is to harden the steel outright by quenching in water or oil and then to bring it back to the required temper by re-heating. This method is not only adopted in tempering tool steels and springs, etc., but also for the heat-treatment of alloy steels—such as nickel, nickel-chrome and chrome vanadium steels, where great toughness is desired rather than hardness. In the latter case, however, the drawing temperature—i. e. the temperature to which the steel is reheated after hardening—is much higher. This form of heat treatment has also been applied to ordinary carbon rail steel to produce what is known as "sorbitic" steel. Now sorbitic steel is also obtained by the patenting process but in a different way; instead of hardening the steel outright and drawing back to the sorbitic condition, this condition is obtained directly in one operation by regulating the rate of cooling.

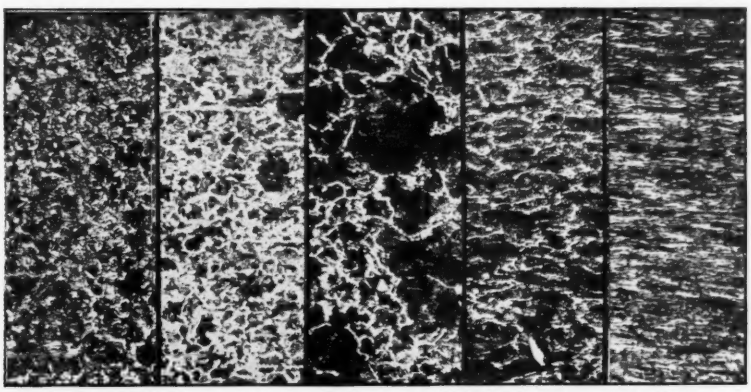
In the patenting process the steel is heated in a furnace not in coils but in single strands, the temperature of the furnace being well above the critical range, usually about 900°C. It is then cooled in air or lead, or by blowing a cold blast on the wire; these methods being varied according to the kind of wire ultimately required and also according to the size of wire and the percentage of carbon in the steel, with a view to obtaining in the steel a sorbitic structure. It is then in a condition to withstand the greatest amount of cold work before a further heat treatment is necessary.

The object of the patenting process is to normalize the steel, remove rolling stresses, and to produce a structure which makes the steel as strong and as tough as possible, without being in the least degree brittle. Fortunately, this tough and strong constituent "sorbite" happens also to be the best constituent for drawing. Sorbitic wire is not, of course, so easily drawn as annealed wire,—i. e. it requires more power and more gradual reduction, but it can be drawn to a much greater extent. Thus, by the patenting process we not only commence with a tougher and stronger rod before drawing, but with a rod which can be much more greatly increased in strength by drawing without becoming brittle.

Having obtained the desired physical condition, either by annealing or patenting, as shown by these photomicrographs, the drawing process is proceeded with, and illustrations of the microstructure of the mild steel and high carbon steel are shown (Figs. 3 to 11) which clearly indicate what happened to the crystals as the drawing process proceeds.

The analysis of the two steels illustrated are as follows:

	I	II
Carbon	0.039%	0.50 %
Silicon	0.019%	0.11 %
Manganese	0.034%	0.46 %
Sulphur	0.033%	0.033%
Phosphorous	0.010%	0.014%
Copper	0.042%	



Longitudinal section Steel II, 0.50% C. Fig. 7. Rod as received. Fig. 8. Ripped one pass. Fig. 9. Patented. Fig. 10. Drawn three passes. Fig. 11. Drawn six passes. (Magnified 120 times.)

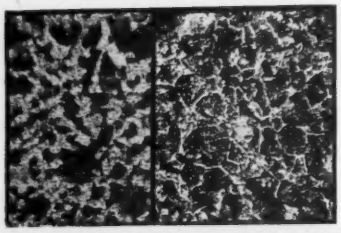


Fig. 1—Inside section of wire. Fig. 2—Outside section of wire. (Magnified 100 times.)

In both annealed mild steels and high carbon patented steels, it will be seen that the crystals gradually elongate until the wire assumes a fibrous structure. At higher magnifications there is little else to be seen in mild steel wire, but as the carbon increases and the patches of pearlite increase in size, the drawing has a tendency to break up the structure, causing the soft ferrite to flow into and between the pearlite; this causes irregular flow, and if carried too far internal rupture will take place. As the carbon content increases still further, the amount of free ferrite diminishes and the pearlite increases until in annealed steels with a carbon content of about 0.85% the structure is entirely pearlitic. Thus, when annealing is the form of heat treatment employed, the capacity of steel for drawing decreases as the carbon content is increased —a fact which a study of the micro-structures readily explains.

As stated previously, however, the semi-tempered or "Patented" steel containing from 0.45 to 0.90% carbon, although it is harder, tougher and stronger than annealed steel with the same carbon content, is yet more ductile in the sense that it has a greater capacity for cold flow and such steel can be drawn, not only a great deal further than the same steel in the annealed condition, but even more uniformly than mild steel.

Patenting of Steel Wire Discussed at Sheffield Metallurgical Association

A very interesting lecture was recently delivered before the Sheffield Metallurgical Association by J. S. G. Primrose on the "patenting" of steel. The mechanism and purpose of the special form of heat treatment known as "patenting" as applied to steel rods and wire were explained as a modified form of overheating, whereby beneficial results were obtained which assisted in drawing to finer diameters without further treatment. The highest tensile values are obtained in this way, accompanied by great toughness under the twist test and in actual use. The process usually consists of steadily raising the temperature of the steel to well above its critical point, maintaining it at this long enough to diffuse the carbon content and considerably enlarge the grain size, and then cooling rapidly enough to ensure the retention of the finest sorbitic structure within the grains. The study of the factors of control to achieve the best results with the different classes of steels used for specific purpose is one of the most interesting problems in practical metallurgy, and necessitates the closest co-operation between the laboratory staff and the operatives.

Mr. Primrose drew contrasts between the oldest form of beehive furnace as used in Britain in which to effect the patenting process and the most modern form of open hearth furnace fired by town gas on the surface combustion method of heating, the former generally requiring regenerative heating to assist it, and the latter dispensing with the usual details of channels, flues and preheaters. He also gave details of the working of the older method, and the chief difficulties encountered in attaining the degree of uniformity necessary for success were discussed. Comparisons were instituted to indicate the numerous advantages, including lower cost, of the modern method as applied continuously to a large number of wires instead of the single piece per furnace in the old style.

Mr. Primrose held that perfect patenting was impossible when the steel selected was dirty, ghostly or segregated, and the need for establishing a standard of acceptance from the steelmaker was advocated if the highest grade of products has to be produced consistently. The absolute necessity of carefully controlling the furnace temperature so as to maintain the formation of the structure required in a properly patented wire was illustrated from cases in which failure to observe this had led to poor results due to unhomogeneous arrangement of the steel constituents. Too hot a furnace is almost equally as disastrous as one which is too cold, and too slow as well as too high speeds of traversing the high temperature region, and then passing through the cooling range, are inimical to the best properties in the finished product.

The lecturer devoted special attention to the middle range of carbon content steels, such as those for spoke wire of various grades, the main feature being the development of such a grain size that the requisite long-fibre structure results from the drawing process after patenting, and is able to stand the heading, bending and vibration to which each individual spoke is subjected. In the lower carbon ranges the need for water-quenching to follow the patenting was pointed out in the manufacture of upholstery and similar spring wire, while in the highest range of carbon steels for rope wire it is sometimes necessary to revert to the lead bath to produce the best physical properties in the finished wire.

New British Specifications for Hoisting Ropes

Reviewed by A. C. Blackall

British Correspondent Wire and Wire Products

ONE of the latest specifications prepared by the British Engineering Standards Association deals with round strand steel wire ropes for colliery winding purposes. This association, which is responsible for the drawing up of the standard specifications for engineering materials and machinery used in the United Kingdom,

TABLE 1

Tensile Breaking Strength. Tons per sq. in.*	Trade Name
80-90	Best Patent Steel.
90-100	Special Improved Patent Steel.
100-110	Best Plough Steel.
110-120	Special Improved Plough Steel.
115-125	Extra Special Improved Plough Steel.

*1 Ton=2,240 lb.

corresponds to the U. S. Bureau of Standards. It was formed in 1901 by the Iron and Steel Institute and the Institution of Civil, Mechanical, and Electrical Engineers, and the Institution of Naval Architects. The association does not, however, embark on its work of preparing specifications on its own initiative, but at the specific request of an authoritative body such as a representative trade organization, a technical society, or a Government department, and to fill a recognized want.

The association is not a profit-making concern. Its only expenses are staff salaries, office expenses and printing. In addition to the financial grants received from the Government and the amount derived from the sale of its publications it has to look to industry as a whole for the funds necessary to carry on the work.

No less than 43 technical and scientific bodies, Government departments, etc., were officially represented upon the committee of the association entrusted with the preparation of the specification dealing with steel wire ropes for colliery winding. These included representatives of the Patented Steel Rope Wire Association and of the commercial wire rope-making interests. This specification is intended to include technical provisions necessary for the supply of the materials therein referred to, but does not purport to comprise all the necessary provisions of a contact.

It is laid down in the specification that standard colliery winding ropes of round strand construction shall be made of wire from steel billets made by the acid open hearth process. The wire shall be of one of the following qualities as specified by the purchaser:—

Grade A. Special acid or "Swedish" quality.

Grade B. Acid quality.

The wire used has to conform to one of the following descriptions specified by the purchaser:

The wire must be of homogeneous steel, cylindrical and free from scales, flaws, inequalities, splits and all other injurious defects and shall be of smooth uniform finish and quality. If the purchaser specifies a galvanized rope, the galvanizing must be carried out by the "hot process" and consist of a continuous uniform coating of virgin spelter of a good ordinary brand containing approximately 97 per cent of pure zinc. When specified by the purchaser, the rope shall be made from wire treated by a special process to resist corrosion. Such ropes shall conform to the requirements, tests, weights and breaking strains laid down for ungalvanized ropes.

When specified by the purchaser, test samples of the galvanized wire taken before stranding shall withstand a copper sulphate test specified.

The circumference (i. e., the circumference of the circumscribed circle) or approximate diameter of the rope must be one of those given in the table of standard sizes. The nominal size of rope recognized by the specification is the circumference. Approximate diameters in metric and English measure are given for purchasers' convenience. The diameter of galvanized wire shall be measured over the zinc coating. The circumference of the rope shall not be more than 2 per cent less than the nominal circumference. or more than 5 per cent larger than the nominal circumference.

The rope shall not be less than the length specified, nor shall it exceed the length specified by more than 2½ per cent, or 20 yards, whichever is the smaller.

The weight of the rope must be in accordance with the table

TABLE 4

Tensile Strength Tons per sq. in.	Number of torsions in a length equal to 100 diameters of the wire		
	Black Wire All gauges	Galvanized Wire	
		.104 in. dia. and smaller	.144-.105 in. dia.

of weights for the size and construction specified, and the amount by which the actual weight of the rope differs from that given in the table shall not be greater than that given in table 2 for the size of rope used.

The central or main core of the rope must be of sufficient size and density fully to support the strands, and must be of fibre or wire construction, as specified. The fibre used must be new acid-free, long fibre, good quality hemp, or manila, or sisal, as may be specified by the purchaser, but in no case must jute be used.

The lay of the rope must be either Lang's lay or Ordinary lay, right hand or left hand, as may be specified by the purchaser, but must not be greater than eight times the nominal diameter. Ropes of Ordinary lay are so constructed that the direction of the lay of the outer wires in the strand is opposite to that of the strands in the rope. Ropes of Lang's Lay are so constructed that the direction of the lay of the outer wires in the strand is the same as that of the strands in the rope.

Wires of lower breaking strength than those used for the other wires of the rope may be used for the core wire of the strands or the main core or heart of the rope. In such cases they shall not be considered as contributing to the strength of the rope.

As far as possible, joints in wires must be avoided, but where they are necessitated by the length of the rope, those in the wires composing the strands shall be distributed as widely apart as possible, and in no case shall more than one wire be joined in a length of 30 feet of strand. Both brazing and electric welding are permitted for jointing, provided that the braze is properly "scarfed" and the electric weld is properly annealed. The tucking of wires is prohibited.

The lengthening of any strand after manufacture to make it suitable for use in "laying up" or "closing" a rope longer than originally intended is prohibited.

The finished rope must be securely and evenly laid and free from injurious defects, kinks, loose wires, open strands, or other irregularities, and must remain in this condition when unwound from the wheel or coil provided that proper precautions are taken and the ends are properly secured.

The wires, the core of the strands and the main core of the rope, while being laid up shall be thoroughly coated and impregnated respectively with a suitable lubricating compound. The lubricant used shall be free from acid or marked alkilinity and shall have no injurious effect on the wires or the material of the cores, and shall be of the proper consistency to be retained in the interstices of the strand or rope.

Inspection and testing, when specified by the purchaser, shall be carried out at the rope manufacturer's works. The manufacturer shall supply all the necessary test samples, machinery, apparatus and labor required for the purpose, and the testing plant shall be under the immediate control of the purchaser or his representative during the tests. This requirement does not apply to breaking load tests.

Each coil or piece of wire used in the manufacture of the rope shall be tested for breaking load and torsional strength by the rope manufacturer and records shall be kept at the manufacturer's works, which shall be available for inspection by the purchaser or his representative The tensile breaking strength of such wire must not be less than the minimum figure given in the table of breaking strengths for the diameter and class of wire used when submitted to the prescribed tensile test. The torsions given by such wire must not be less than those given for the when tested by the prescribed torsion tests.

In order to obtain special samples for the mechanical tests required by this specification a suitable length shall be cut off

(*Continued on page 30*)

TABLE 3

Tensile strength of wire Tons per sq. in.	Torsions in a length equal to 100 diameters of wire.		
	Black Wire All gauges	Galvanized Wire	
		.104 in. dia. and smaller	.144-.105 in. dia.
80 - 90	34	28	23
90 - 100	34	28	23
100 - 110	32	23	19
110 - 120	30	15	11
115 - 125	28	10	7

TABLE 2

Circumference of Rope	Permissible Variation	
	Above per cent.	Below per cent.
2 3-8—4 3-4	4	4
4 7-8 and larger	5	5

Table 5

Diameter of Wires. In.	S. W. G.	No. Immersions	Duration of Immersions.
.104 and over	12 and over	4	1 minute
.103 to .072	Below 12 to 15	3	1 minute
.071 to .036	Below 15 to 20	2	1 minute
.035 to .020	Below 20 to 25	3	½ minute

The Recent History of Wire Rope Testing in Germany

By Professor C. Bach, Stuttgart

Translated from the Montanistische Rundschau by Paul H. Wueller

This article, written by one of the well known German authorities on wire, throws interesting light on the recent history of research in the German wire industry.

The Jubilee-Foundation of the German Industries some years ago appointed a committee which was to compile, classify, and compute experiences and observations with respect to wear and tear of rope-wire. This committee furthermore was supposed to provide for permanent laboratory tests. The practical aspect of these tests was to be stressed.

The investigation concerned itself chiefly with the life of rope-wire and attached special weight to the discussion of the following points:

WEAR AND TEAR limit the life of rope-wire. Hence, rope-wire has to be inspected in order to reduce the number of disturbing and fatal accidents. This inspection has to take place no matter how carefully ropes have been calculated.

It is the first task of the committee to specify the factors which tend to shorten the life of rope-wire. The endeavors in this direction have yielded so far the following results:

(1) The *actual* strain is by far greater than customarily assumed as our present methods do not permit absolutely exact calculation.

(2) The *individual* wires of the rope are damaged while the latter is in operation:

(a)—whenever they are pressed against the drums. This "squeezing" and "rubbing" results in a more or less marked change of form and general weakening.

(b)—whenever the individual wires are rubbed against one another (internal contact).

The protective lubricant is forcibly removed by friction as stated in (a) and (b).

(3). The wires rust, their cross-section diminishes, and they finally turn brittle.

(4) Ill-designed plants and machinery—the latter category includes the rope—faulty construction and inefficient attendance as well.

In my capacity as chairman of the committee I circulated the above-mentioned"danger-points" of rope-wire and invited the industry to submit observations which might assist in clarifying the situation. I shall permit myself to present in the following the information obtained as it is of much practical value and I shall be pleased to acknowledge inquiries or replies pertaining to the subject:

(A) Observations of The Royal Test Laboratories Berlin-Lichterfelde, submitted by Herr Geh. Regierungsrat Prof. Rudeloff, member of the committee.

(1) Tests of Rope-Wire that had been damaged while in Operation.

The laboratories often have had occasion to test damaged or torn rope-wire and to investigate and analyze its causes. The observation on the appearance of such rope-wire make it evident that the process of wear had begun with "squeezing" and "rubbing" of the individual wires. This "squeezing" usually has been followed by fracture of the individual wires and subsequent rupture of the rope. To my knowledge, there have been no ruptures of rope-wire that could not have been avoided if attention would have been paid to the advanced wear of its individual wires. It is in this connection that I wish to refer the reader to an order of the Department of Mines which requests the operators to apply daily before commencement of the work what might be called the "wool-test." This test is performed by running the entire rope through a handfull of woolen refuse such as is sometimes used for wiping greasy parts of engines. If certain parts of the rope "catch" particles of the refuse, chances are that these parts are damaged, and that close investigation—sometimes followed by removal of the rope—is imperative. This simple test in combination with close inspection will go a long way toward elimination of rope ruptures and fatal accidents.

TABLE 1

Rope	1	2	3
Total numbers of wire in the rope	294	210	294
Wire diameter (mm)	0.70	0.68	0.59
Total cross-section (sq. mm.)	113.1	76.3	80.4
Diameter of rope (mm.)	20	17	17
Tensile strength (kg) of rope	12.875	9925	9625
Tensile strength of wires (kg/M. mm.)	130-140	190-200	190-200

TABLE 2

Number of Rope		I	II	III
Test number		1	2	3
Tension (in %) at a strain of	810kg	0.25	0.05	0.08
	1790kg	0.40	0.25	0.18
	2755kg	0.75	0.35	0.33
	3600kg	0.95	0.50	0.60
Number of oscillations:		13.144	5002	10.000
Gain through tension (in %):		0.15	0.28	0.33

The reports furthermore illustrate a few striking examples of rope ruptures.

One of these cases very well demonstrates the deterioration of those parts of the rope that are in constant contact with the drum. In this specific case, a one-sided, local cold-drawing took place which caused local brittleness and final breakage of the bent rope.

Another example calls attention to the influence of purely local weakening upon the entire condition and safety of the rope. This local depreciation deserves close attention, although fractures of the individual wires may not have occurred yet. This case once more emphasizes the importance of rope-tests in compliance with all safety regulations—thorough general inspection and laboratory tests of rope parts—and it suggests that conscientious performance of these tests will lead to the detection of all rope which no longer assures absolute safety.

The tests, however are not always performed with the necessary accuracy. There are a number of ropes in operation whose external appearance indicates that they are no longer dependable and safe. We shall cite two cases which will illustrate this. One of the ropes under consideration had been used for hoisting purposes, the other for hauling of coal in a mine.

A hauling rope tore while in operation and it was our task to determine whether the rope had been already in objectionable condition upon delivery or whether it had been subject to such excessive and extreme strain that it could not have been considered safe before the rupture took place.

The rope under consideration was a so called flat-rope. It consisted of six parallel, round worked ropes which in turn consisted of four strands each of which were worked alternately clockwise and counter-clockwise around a hemp core. Each strand contained eight wires of 2 mm. dia. and a hemp core. The strands were worked to the left. Four sample pieces were taken out of the rope in order to perform the test.

Specimen 1 was 0.9 m. long and consisted of a set of 192 disconnected wires. It had been taken right above the binding.

Specimen 2 measured 5.5 m. in length. It had been taken above the rupture.

Specimen 3 had been taken approximately 130 m. above the rupture, right at the point where the first fractures of the individual wires had been noticed.

Specimen 4 had been taken from that end of the rope that has customarily remained reeled upon the drum.

The original tensile strength of the wires of the rope (upon delivery) was said to have been: 396kg=126 kg/sq. mm.

Eight wires of specimen 4 rendered the following values: 412, 382, 410, 390, 388, 372, 368, 418 average: 393 kg.

The close agreement between this average and the original tensile strength permits the assumption, that the properties of that part of the wire which always has been on the drum, had not undergone any changes. This observation is of importance as it suggests that one may easily determine the original tensile strength of used rope-wire by taking a specimen from that part of the rope that always remained on the drum, provided, of course, that these parts have not been damaged by rust, etc. Specimen 4 also has been subjected to a flexure—and torsion-number test. Fracture occurred at 16 blendings and 44 torsions.

All these tests show that the rope originally had complied with all requirements.

The question whether or not the rope had to be considered "safe" shortly before the rupture took place, had to be answered in the negative. The general appearance of the rope as well as the condition of specimens (2) and (3) indicated a state of advanced weakening caused by rust and wear. All alarming symptoms had been overlooked because the rope had been thickly covered with grease and dirt. This case proves once more that thorough cleaning prior to the regular inspection is a necessity.

The examples related above, clearly indicates, that the durability of rope-wire which runs in guide-rollers over reels, largely depends upon the deterioration of the individual wires. Those parts of rope which are in constant contact with the guide-rollers and the reels show extra-

(*Continued on page 24*)

TABLE 3

Test limit	Rope	Dia. of pulley mm.	Number of oscillations: Test Number: 1	2	3	Average:
Beginning of the wire fractures:	I	500	11,210	9,240	9,410	9,553
		250	2,570	2,490	....	2,530
		120	1,620	1,630	....	1,625
	II	500	17,080	8,550	8,410	9,013
		250	3,290	3,560	....	3,425
		120	1,500	1,630	....	1,565
	III	500	9,120	7,680	8,360	8,387
		250	2,110	1,920	....	2,015
		120	1,170	1,120	....	1,145
Rupture of the Rope:	I	500	13,830	13,170	13,870	13,623
		250	5,560	5,530	....	5,545
		120	2,780	3,080	....	2,930
	II	500	17,700	18,470	20,940	19,037
		250	8,280	8,940	....	8,610
		120	4,380	3,590	....	3,985
	III	500	12,840	11,810	12,300	12,314
		250	4,470	4,620	....	4,545
		120	1,980	2,230	....	2,105

Abstracts of Current Literature on Wire

Built-up Wire Ring May Replace Forgings

A novel device just worked out, proven and patented by the Baldwin Locomotive Works, Eddystone and Phila., Pa., is constructed of wire and may displace more expensive forgings, says a writer in Engineering News Record, August, 1927. This is a ring of fairly large diameter for use with cranes or hoists and large loads. Usually forged or welded bars, which have been bent round are used. The new form consists of wire coiled on a spool to the required diameter and of sufficient number of layers to have the requisite strength. This wire-wound ring is then heated and compressed under a hydraulic press or heavy hammer to compact the wires into a solid unit. One of these 9½ in. inside diameter, 2¼ in. in cross section, sustained 230 tons before it parted.

Lubrication Important for Crane Wire Ropes

THE selection and care of wire rope for hoists and cranes, according to a writer in Gas Age-Record, Aug. 13, 1927, are highly important, since lives may hang on the proper choice. Safety factor is most important. The Amer. Cable Co. says there are three types in ordinary use, 6x19, 6x37 and 8x17. Plow or improved plow steel grade of wire is used. Sheaves and drums should have minimum cable diameters of 30, 20 and 20 in. for these types. On equipment working with capacity loads, the 6x37 type is preferable. A factor of safety no lower than 7 should be used. On hot-metal cranes, or any work in which the cable becomes heated, 7x7 is a good form with a wire center. Heat chars the usual hemp center, which weakens the rope altho it appears as strong as ever. In this work the safety factor should be 8, minimum drum diameter 30 in., and service limited to 9-15 months. Rigid and frequent inspection is absolutely necessary. Lubrication is important. Cores are impregnated but frequent applications of a good lubricant are necessary to prevent drying out. Dry cores start moisture and permit the beginning of corrosion of the inner wires adjacent to the dry core. Either that or the dry cores suck the lubricant away from the outer wires so these are without lubricant. The best lubricant is a thick semi-plastic compound applied hot but thinned by the heating so that it penetrates all parts.

Highway Wire Guards Important Outlet

THIS is another of the articles in the series of Large Uses of Steel in Small Ways, Iron Trade Review, July 14, 1927. Steel wire is woven into fences and these are widely used as highway guards, more especially out in the open country where the roads are laid and maintained by State highway departments. Some 38 States have adopted this woven wire fencing as standard. Usually the basis is an open-hearth wire following the tentative specifications A82-21T of the Amer. Soc. Test Mtls. No. 6 gauge wire .192 in. diam. is used, woven into a square mesh, sides 2 in. apart, horizontal and vertical wires forming diagonals. The standard width is 24 in. It is heavily galvanized after weaving, the coating being about 1.2 oz. per square foot of surface and so put on as to withstand four dips minimum by the Preece test. The wire as delivered is usually tested by unwinding and straightening in a vise, then selected specimens of this straightened wire must withstand a minimum of 60,000 lbs. per sq. in. tensile strength. It is estimated that this highway guard totals 2,500 to 3,000 tons a year, and this total is increasing. In addition the fastening staples which are 2 in. long, and run 33 to the pound, bulk up.

Marked Advantages of Wire Saws in Quarrying

ACCORDING to the Bureau of Mines, Dept. of Commerce, there is a very marked advantage and economy in the substitution of wire saws for usual methods of quarrying slate and other rocks. This, as described in Report of Investigation No. 2820, July 1927, has many advantages besides reducing waste, speeding up the work and cutting costs. It is widely used in Europe and the machines tested in Vermont slate quarries were imported. The wire consisted of three-strand cable 3/16 plus. in diameter, running as an endless belt 600-900 ft. long. It was driven by a 7½ h. p. electric motor so as to travel 14.3 ft. per second. Pulleys are adjusted radially with ball and socket joints in the supports to permit free adjustment. The support is a steel I-beam, one of these being used at each end of the cut. Sand and water are fed onto the fast-moving cable and do the actual cutting. When an open space is not available a 36-in. hole drilled for the I-beam standard to set in, this being done by means of a special imported hollow drill. The wire runs at an angle for inclined cleavage, or horizontal as desired. As a means of comparison, the ordinary method of cutting produces a channel 3 in. wide at the top, tapering or narrowing down to 1¾ in. at the bottom in 8 ft. of depth. The wire cuts a ¼ in. slot at all times and in any or all directions. Among the advantages claimed, as a result of actual tests over a period of many months, are less power used, first cost is but one quarter, labor costs is one half or less, it is more rapid and continuous, the proportion of waste is reduced, simplicity and ease of operation. On cuts 80-90 ft. long the center will be higher than the ends, due to the flexibility of the wire cable, unless a tension of 1,000 lbs, or more is maintained. The development of this process and use of this equipment in the country's thousands of quarries would provide a new outlet for a tremendous quantity of wire cable.

Sleeper & Hartley TRADE MARK

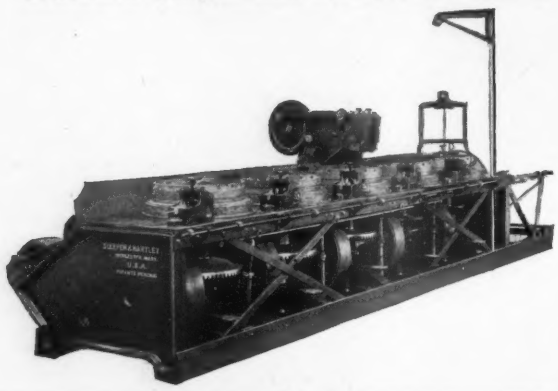
Practical Continuous Wire

These Machines Go Into Production at once—R

Rod Frame

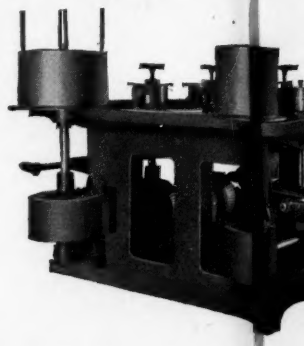
(No. 5—14 or 15 wire)
Patented June 3, 1924—May 12, 1925—others pending

All Ball or Roller Bearings
No Differential Gearing.
Automatic Compensation for Speeds of Heads.



Double 5-Draft Dry,

No. 14 to No. 23. Fi or l
3 to 4 Blocks t verag
No. 14 to 19—4 h 1400
No. 14 to 20—5 h 1100
More than 250 heads of thi prove



WIRE MILL EQUIPMENT

TINNING AND GALVANIZING FRAMES AND WIPERS

PATENTING FURNACE TAKE-UPS

WIRE POINTERS. WIRE PULLERS

WIRE SPOOLING DEVICES

MULTI-HEAD WIRE STRAIGHTENING AND CUTTING MACHINES

WIRE TWISTING AND STRANDING MACHINES

AGENTS: CHICAGO TERRITORY,
Neff, Kohlbusch & Bissell, Inc.

SLEEPER & IA

FOREIGN AGENTS AND REPRESENTATIVES: UNITED KINGDOM—Mr. Fredk. A. Perry, 63 Queen Victoria St., London. E. C. 4. FRANCE—Mr. Edgar Bloxham, 12 Rue du Delta, Paris. BELGIUM—Isbecque, Todd & Cie., 25-27 Boul. Emile Bockstael, Brussels.

WORCESTERMA

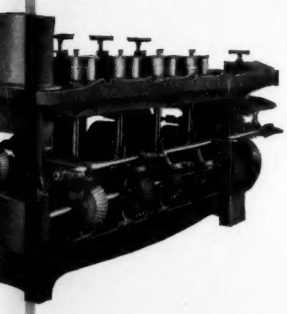
Wire Drawing Machinery

Sleeper & Hartley TRADE MARK

at ce—Reducing Overhe ad-Increasing Production!!

ftry, Intermediate

3. h or low carbon wire.
s t verage Operator.
4 h 1400 lbs. per block.
5 h 1100 lbs. per block.
thi proved model in operation

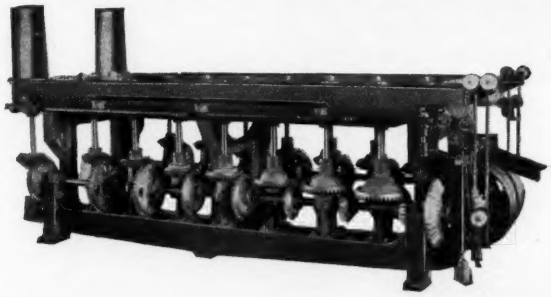


Double 8-Draft Fine Wire: Wet

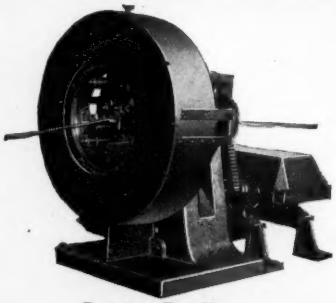
No. 22 to 36. High or low carbon wire.

6 Blocks to Average Operator, 22-33, 8-hole, 660 lbs. per day of ten hours.

Many thousands of these heads in operation



ARMORING MACHINES FOR



Patents Pending

"BX," PARK CABLE MOTOR WIRES, HOSE Etc., Etc.

High Productive Speeds

LOCK WASHER MACHINERY

with Enormous Output

HIGH SPEED STRANDING MACHINERY

IARTLEY, Inc.

Agents: Philadelphia Territory
Swind Machinery Co.

ITALY—Henry Coe & Clerici, Milan. AUSTRALIA AND NEW ZEALAND—Edwin Wood Pty., Ltd., Melbourne.
JAPAN—Andrews & George Co., Tokyo. SWEDEN AN D FINLAND—Akt., Rylander & Asplunds, Stockholm.

R, MASS., U. S. A.

News of the Industry

THE Texas Nail & Wire Mfg. Co. has filed application for a charter for the manufacturing of wire and wire products. The capital stock of the company is $500,000.

The plant covers a ground area of two acres and it is expected that the plant will be complete during the latter part of January.

The plant is designed to produce wire both bright and galvanized. About 150 workmen will be employed and the plant will run on a ten-hour shift for the first year. The production will be about 30,000 tons of wire products on this basis.

The wire drawing mill is made up of 96 wire drawing blocks and the nail mill is equipped with 63 of the latest pattern nail machines. The galvanized plant is capable of galvanizing 36 strands of wire simultaneously. As it is expected that the greater position of the products will be sold on the gulf coast, special attention is being paid to the production of salt-air resisting barbed wire.

THE American Steel Wire Co. has installed a $2,000,000 billett rod mill at its South Works. The work and the equipment is that of the Morgan Construction Co. and will insure the yearly output of 100,000 tons of rod. The previous record for speed was 3,500 per minute but it is expected, with the new equipment that the capacity will be stepped up to 4,200 per minute.

THE Soviet Russian Government has contracted for the construction of a steel mill at Makieffa, Southern Russia. The reported cost is 20 million dollars. American methods and machinery will be used.

WHEN the new additions to the plant have been completed, the company will have put into active operation all of the 33,000 sq. ft. of floor space in the comparitively new building.

Domestic Exports of Iron and Steel Wire, Wire Rope and Nails, From the United States, By Countries

October, 1927

Countries	Plain iron or steel wire	Galvanized wire	Barbed wire	Wire rope	Insulated iron or steel wire and cable	Wire nails
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Austria	.....	22,573	.....	.....	.....	.....
Bulgaria	.....	8,992	.....	.....	.....	.....
Denmark & Faroe Is.	6,619	.....	.....	299	.....	.....
France	4,000	.....	.....	.....	.....	.....
Germany	10,188	.....	.....	.....	.....	.....
Greece	.....	35,926	.....	.....	.....	.....
Norway	1,905	.....	.....	.....	436	.....
Rumania	.....	.....	.....	6,810	.....	.....
Sov. Russ. in Eur.	65,000	.....	.....	.....	.....	.....
Spain	1,310	2,334	.....	.....	298	.....
Sweden	600	.....	.....	.....	.....	.....
Turkey in Europe	.....	35,912	.....	.....	.....	77
United Kingdom	94,943	140,533	.....	.....	.....	42,810
Canada	695,106	1,871,324	400,988	37,545	2,792	8,665
Br. Honduras	9,602	.....	1,191	450	.....	300
Costa Rica	2,268	738	42,600	3,433	2,831	1,292
Guatemala	235	1,248	161,152	5,189	.....	27,520
Honduras	.....	2,130	101,835	5,174	.....	41,450
Nicaragua	649	1,300	183,175	111	11	69,092
Panama	4,040	25,622	.....	88,652	.....	72,152
Salvador	540	376	86,040	1,460	.....	1,500
Mexico	50,790	30,409	502,173	79,502	9,179	37,808
Miquelon & St. Pierre	.....	.....	.....	.....	.....	400
Newfld. & Labr.	4,442	2,208	.....	3,620	.....	4,570
Bermuda	132	.....	.....	.....	.....	.....
Barbados	.....	.....	.....	622	.....	.....
Jamaica	717	864	.....	1,644	.....	6,750
Trindidad & Tobago	.....	.....	.....	7,540	3,260	.....
Other Br. West In.	800	1,000	275	1,178	.....	16,595
Cuba	11,404	65,288	555,615	67,190	30,437	275,670
Dom. Republic	1,217	.....	206,300	2,454	.....	45,100
Netherland West In.	120	.....	2,750	4,295	.....	10,587
Haitian Republic	1,385	.....	.....	14,253	1,260	25,300
Virgin Is. of U. S.	.....	.....	5,000	.....	.....	1,200
Agentina	448,518	1,927,686	1,909,168	4,296	.....	136
Bolivia	.....	.....	.....	7,477	.....	.....
Brazil	81,979	79,278	2,231,708	2,660	.....	1,000
Chile	7,615	148,023	72,531	10,177	5,448	2,093
Colombia	171,661	84,796	655,990	35,063	8,483	202,306
Ecuador	.....	.....	240,506	.....	383	6,000
Surinam	.....	.....	.....	.....	1,370	.....
Peru	111,007	46,750	134,000	16,447	.....	126,135
Uruguay	.....	58,964	.....	.....	.....	.....
Venezuela	6,575	400	148,375	21,585	604	53,782
British India	.....	.....	.....	1,667	1,112	.....
British Malaya	.....	.....	22,500	600	.....	200
China	1,500	246,732	.....	.....	.....	501,862
Java & Madura	.....	.....	50,155	.....	.....	41,070
Other Netherland East Indies	.....	.....	134,592	.....	.....	.....
Hongkong	.....	.....	.....	.....	.....	2,350
Japan, inc. Chos.	1,315	.....	.....	.....	3,795	1,540
Kwangtung	.....	.....	.....	23,575	.....	.....
Philippine Is.	2,662	9,119	1,792,750	159,275	1,119	456,000
Turkey in Asia	.....	11,294	.....	.....	.....	.....
Australia	299,971	.....	107,520	6,297	200	1,015
Brit. Oceania	.....	.....	15,960	.....	.....	9,780
French Oceania	.....	.....	5,140	.....	.....	2,500
New Zealand	500	.....	.....	.....	15,597	876
Br. South Afr.	480	207,600	1,186,244	1,697	.....	1,108
Br. West Afr.	.....	300	.....	.....	.....	.....
Egypt	.....	16,120	.....	.....	.....	.....
Liberia	.....	.....	.....	.....	582	.....
Mozambique	.....	53,800	151,500	.....	.....	.....
Other Port. Afr.	.....	171	.....	.....	.....	.....
Total Quantities	2,101,795	5,139,810	11,107,733	621,583	89,197	2,098,591
Total Values	100,153	138,257	310,711	92,628	14,394	67,480

Shipments from the United States to Non-Contiguous Territories.

	6083 Wire		6092 Wire Nails	
	Pounds	Dollars	Pounds	Dollars
Alaska	104,961	13,435	61,498	3,022
Hawaii	230,985	25,738	204,362	6,235
Porto Rico	213,198	13,170	165,154	5,659

THE Torrington Mfg. Co. of Torrington, Conn., has purchased the Tiley-Pratt Co. of Essex, Conn. Both companies

(*Continued on page 22*)

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are manufacturers of wire spokes and nipples. The plant will be under the management of Morton C. Tiley and Paul N. Sampson.

William Pendleton Palmer, president of the American Steel & Wire Co., Cleveland, and a director of the U. S. Steel Corp. died at his home in Cleveland Heights. He was 66 years old and has been ill since last summer.

Mr. Palmer started in 1878 as a steel salesman with Leuro, Oliver & Phillips. In 1888 he became secretary of Carnegie Steel Company.

When the Steel Corporation was formed with the Wm. Steel & Wire Co. as one of its companies. Mr Palmer became president of the latter company.

One of the leading men of the Steel industry, Mr. Palmer left an enviable record behind him.

THE Holyoke Company, occupying the plant previously (owned) by the Century Machinery Co. of Holyoke, is installing new machinery for the purpose of expanding its production of rubber-covered wire for electrical use.

A ONE story building 252x 552 feet is being erected by the Williamsport Wire Rope Co. of Williamsport. A bond issue of $1,600,000 will finance this and other products.

British Cable Makers Want Mark of Origin on Imports

IMPORTED insulated electric cables and wires are the subject of an application now being heard before the Standing Committee of the Merchandise Marks Act in London. Sir H. Llewellyn Smith is presiding at the hearing, and the application has been made by the Cable Makers' Association, which has asked for an order for the marking of these imports with the country of origin.

Domestic Exports of Iron and Steel Wire Manufactures, Horseshoe Nails and Horseshoes From the United States, By Countries

October, 1927

Countries	Woven wire fencing	Wire cloth & screening		Wire n. e. s. & manufactures of	Horseshoe nails	Horseshoes
	Pounds	Pounds	Dollars	Pounds	Pounds	Pounds
Belgium	.....	.....	.....	485	.....	.....
Czechoslovakia	.....	.....	.....	658	.....	.....
Denmark & Fr. Is.	.....	.....	.....	16,362	.....	.....
Finland	.....	.....	.....	1,113	.....	.....
France	.....	.....	.....	6,518	.....	.....
Germany	.....	.....	.....	70	22,628	.....
Greece	.....	434	99	.....	.....	.....
Netherlands	.....	.....	.....	249	4,854	.....
Norway	.....	.....	.....	2,076	.....	.....
S. Russia in E.	26,381	15,664	1,172	.....	.....	.....
Spain	.....	.....	.....	125	.....	.....
Sweden	.....	.....	.....	5,518	.....	.....
Switzerland	.....	.....	.....	98	1,925	.....
United King.	76,525	132	34	28,151	.....	.....
Canada	8,626	132,054	12,063	537,626	25,621	177,344
B. Honduras	.....	.....	.....	205	200	.....
Costa Rica	.....	80	120	1,990	900	1,500
Guatemala	1,679	1,927	209	3,240	3,500	.....
Honduras	2,724	4,721	810	1,446	200	.....
Nicaragua	1,848	16,447	1,408	2,362	.....	2,200
Panama	1,426	9,990	908	8,784	.....	2,108
Salvador	1,846	.....	.....	.....	700	.....
Mexico	29,680	33,136	5,708	52,993	92,997	3,600
Newfoundland & Labrador	.....	.....	.....	194	1,250	.....
Bermuda	403	1,262	306	1,567	.....	1,800
Jamaica	2,291	2,428	202	2,114	.....	.....
Trindidad & Tobago	444	1,441	214	2,496	.....	.....
Other B. W. Ind.	1,155	3,218	527	2,617	.....	.....
Cuba	67,415	8,956	1,262	119,530	6,300	1,400
Dominican Rep.	5,672	7,808	943	12,929	.....	800
Neth. West Ind.	3,695	2,926	557	4,012	.....	.....
Haitian Rep.	341	656	99	2,031	.....	.....
Virgin Is. of U. S.	800	.....	.....	.....	.....	1,605
Argentina	49,603	11,857	2,012	38,315	.....	6,000
Bolivia	.....	5,167	1,690	2,570	.....	.....
Brazil	.....	10,645	1,342	8,834	.....	.....
Chile	983	1,274	464	4,447	8,054	.....
Colombia	22,135	11,049	1,734	6,751	23,400	.....
Ecuador	207	.....	.....	4,270	.....	.....
B. Guiana	.....	.....	.....	126	.....	.....
Surinam	.....	.....	.....	65	.....	.....
Peru	.....	7,065	709	22,235	.....	.....
Uruguay	.....	3,901	497	9,377	.....	.....
Venezuela	10,513	5,634	1,208	15,906	2,840	.....
B. India	148,006	.....	.....	70,070	.....	.....
B. Malaya	28,046	.....	.....	3,274	.....	210
Ceylon	.....	.....	.....	46,266	.....	.....
China	600	171	121	6,141	2,800	.....
Java & Madura	2,772	.....	.....	2,614	.....	.....
Other Neth. East Ind.	.....	.....	.....	1,164	.....	.....
French Indo-China	.....	.....	.....	2,880	.....	.....
Iraq	.....	.....	.....	1,224	.....	.....
Japan	333	840	218	155,796	15,500	.....
Kwantung leased territory	.....	.....	.....	2,125	.....	.....
Philippine Is.	116,237	14,942	2,227	7,243	2,100	3,350
Siam	.....	364	64	.....	.....	.....
Syria	.....	.....	.....	960	.....	.....
Australia	.....	78,878	13,398	20,165	13,122	26,632
B. Oceania	.....	.....	.....	132	.....	.....
F. Oceania	.....	.....	.....	250	.....	100
N. Zealand	.....	2,647	926	14,350	13,013	1,400
B. S. Africa	2,074	24,216	6,870	4,337	350	.....
B. W. Africa	.....	3,894	411	.....	.....	.....
Egypt	.....	.....	.....	1,628	.....	.....
Liberia	927	.....	.....	1,127	.....	.....
Mozambique	799	13,729	2,572	2,629	.....	.....
Other Portuguese A.	417	.....	.....	.....	.....	.....
Total Quant.	618,603	439,554	.....	1,274,830	242,234	170.049
Total Values	31,959	.....	63,104	119,979	22,780	13,567

Mr. Moritz, K. C., counsel for the applicants, said at the opening of the inquiry that the Cable Makers' Association represented an overwhelming proportion of the manufacturing trade of the United Kingdom. Its membership consists of eighteen limited liability companies, with an aggregate capital of £12,000,000 ($60,000,000). The annual production of heavy insulated cable by members of the Association amounts to £16,500,000 ($82,500,000). The imports amount to £710,000 ($3,550,000). That, at least, is the amount declared to the Customs, but there is reason to believe a good deal of material is imported under other descriptions.

Part of the hearing was in private in order that Mr. Atkin-

(*Continued on page 24*)

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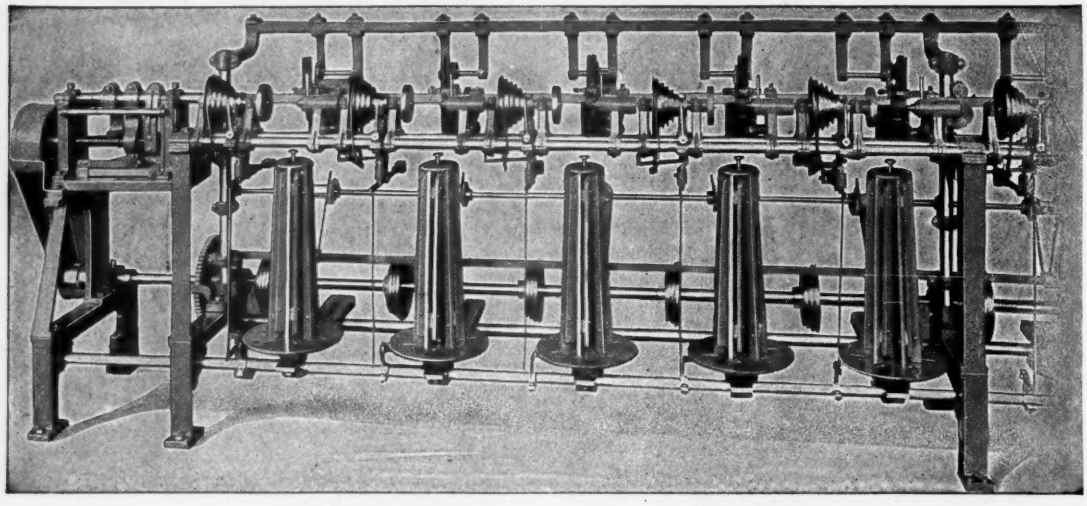

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Wire Spooling and Winding Machines of Every Description

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(*Continued from page 22*)

son could be questioned on a statement that cables were imported, covered with braid, and then sold as British.

N. L. Macaskie, counsel for the Electrical Importers and Traders' Association, who opposed the application, suggested that as imports were only 3.3 per cent of British production, it was ludicrous to speak of such a percentage constituting unfairness.

History of Rope Testing

(*Continued from page 16*)

ordinary tendency to turn brittle, because flexure is greatest at that point. This observation furthermore is supported by the fact that it has been noticed that the individual wires sometimes break where they leave or re-enter the strand. This fracture can hardly be considered as a consequence of flexure, but can be traced back to the phenomena mentioned under (b).

The cited examples furthermore show that proper inspection of thoroughly cleaned ropes will easily lead to the discovery of the damaged parts, and the present accident-prevention-measures in Germany are fully justified. I admit that rigid examinations sometimes will lead to unnecessary removals of slightly damaged rope, but I am convinced that it would be more expensive to lower our testing standards. The problem is in the final analysis an economic issue. It should be noted that a lowering of the standards, that is to say, if wire of a smaller diameter and class of wire used our entire plant equipments would have to be altered or replaced. Viewing the matter from this angle, it should be one of the tasks of the laboratories to determine the effects of wear and tear upon rope-wire, their main effort, however, should be directed toward determination of the relation between tenacity of the metal and of the finish-

ed rope. Investigations as to the suitability of various strand arrangements, too, should take a prominent place in their program.

It seems to me of great significance to investigate the causes which are responsible for deterioration of rope-wire under normal working conditions. It appears to me that a reduction of this deterioration could be effected by careful choice of the metal and the rollers as well as by improving the design of the rope itself. I am of the opinion that deterioration is chiefly caused by the "sliding-motions" which take place in consequence of bending whenever the rope runs on or off the roller or the barrel of the drum. The flexure of the rope results in displacement and varying velocity of the strands, a phenomenon, which in turn is responsible for the so called "slipping" of some strands on the drum. This "slipping" causes pressure at contact points of the adjacent strands. Very tightly worked rope offers high resistance to such displacement and assumes to some extent the characteristic of a rod. The wear of the wire decreases as a result of the decreased displacement of strands. Tightly worked rope, however, requires wires of higher flexibility because the strands of such rope must hug the pulley, while the strands of loosely worked rope—on account of the above described displacement tendency — preserve their normal incurvation when running over the pulley. The intensity as well as the extent of this "hugging" furthermore is determined by the structure of the rope. The so called "round lay" is less often subject to it than the so called "cable-lay", because the individual wires of the former run more frequently on the rope surface and also because the rigidity of relatively thick wire is superior to that of thin wire. The core of the rope and the cores of the strands, also have some influence upon the flexibility of the former. A hempen rope-core

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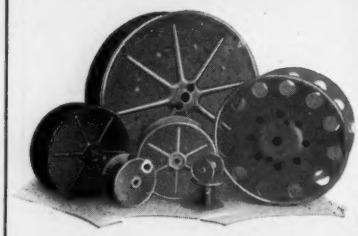

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makes for displacement of the strands, while hempen cores in the strands increase the flexibility of the individual wires.

The above broached problems should be extensively and exhaustively investigated in the experimental laboratories. The research should cover the properties of various wires, the arrangement of these wires in different strands, and also the various structures of rope and their relative advantages.

Repeated Strain Tests

The results of the repeated bending tests performed in the Royal Testing Laboratories have been considered in my essays: "Report covering the Results of the Preliminary Tests of Wires and Strands for the Purpose of determining the Influence of Structure upon the Tensile Strength of Rope-Wire", which appeared in the "Mitteilungen" 1897. Vol 3 and 4. These experiments have been performed with Marten's Testing Machine. This machine merely measures the actual alternate bending and does not make any allowance for subsidiary influences to which the rope is subject when in actual use. The principles of a machine which provided for the registration of these influences had been devised by me as early as 1893.

The actual construction of my apparatus, however, had to be deferred, as it proved difficult to secure the necessary financial backing. One repeated strain test, however, had to be performed upon request. The request offered a welcome opportunity to test three different ropes. The pulleys of the testing apparatus were arranged one above another, and the machine was driven from the upper one. The angle of oscillation was 30 degrees and the weight —brought to bear upon the rope by a lever connected with the lower pulley—was 3600 kg. At the first trial (45 oscillations per minute) the rope became rather hot and compelled us to reduce the speed to 25 oscillations per minute. The rope was not greased while tested.

The three ropes were subjected to three separate tests each. One test was performed with pulleys of 500 mm dia. and two tests with pulleys of 250 and 120mm dia. each. The oscillations were counted up to the fracture point of the individual wires and the rupture point of the rope respectively.

The three ropes (1, 2, 3) consisted of six main strands which were worked counter-clockwise around a hempen core. The main strands were coiled clockwise; they consisted in the case of rope (1) and (3) of 7 secondary strands (one serving as core), and in the case of rope (2) were composed of 5 secondary strands and a hempen core.

The secondary strands consisted of 7 zinced cast-steel wires (one serving as core) which were worked counter-clockwise.

The hempen cores were twisted to the right. The core of Rope 1 contained 16 cords, and the cores of Rope (2) and (3) contained 10 cords each.

The ropes themselves were specified as in Table 1.

The tension of the three ropes was measured between the pulleys and the measuring was done under strain and after a certain number of alternate torsions. Table 2 shows the values arrived at:

The final results of the alternate torsion-test may be read from Table 3.

We furthermore subjected a sample piece of rope 1 under gradually increasing strain (pulley dia. 500mm) to 26.283 oscillations per minute. We thereupon divided this sample piece into four parts—two taken from the section that had not yet been bent and two from the part that had undergone the procedure—and tested these parts again. These tests proved that the tension of wire that had been subject to torsion only was greater than that of wire which had been subject to torsion and flexure e.g. the tension under a strain of 10,500kg ran in the case of the former up to 2.8% and in the case of the latter to 2.3%.

The strain or weight on the sample pieces that had previously been subjected to torsion was 12,400 and 12,700 kg, respectively, or 12,550 on the average. The strain (weight) on the wire that had been subject to torsion and flexure was 13.300 and 12,-000 kg, respectively, which equals an average of 12,150 kg. The breaking-weight for the latter was slightly lower, although, these samples already showed at one spot a number of fractures which resulted from the alternate-torsion-test.

In conclusion we may summarize the results of our investigation as follows:

(1) Mere torsion tests do not permit of reliable judgment as to the degree of deterioration of rope-wire.

(2) Rope 2, under the alternate-torsion-test, proved to have the highest resistance and Rope 3 the lowest. The cross-section of the ropes were approximately the same also the tenacity of the wire metal. The number of wires in Rope 2, however, was considerably lower than the number of wires in Rope 3, and the main strands of Rope 2 contained a hempen core while Rope 3 had a wire core.

(3) Rope 1 proved to be of lower resistance than Rope 2, although the cross section of the former was 113 sq. mm., while that of the latter was but 76.5 sq. mm. Whether the superiority of Rope 2 was due to the fact that its main strands contained hempen cores while the cores of Rope 1 consisted of wires, or whether the superiority was due to the harder substance of Rope 2 can not be decided because the experiments have not been exhaustive. It may well be, however, that both factors are equally responsible.

(B) Observations of the Testing Laboratories of the Royal Technological College in the City of Stuttgart, Germany.

The observations of the above institution have been published in the organ of the Bayerischen Revisionsvereins in March 15th and March 22nd 1915. It may

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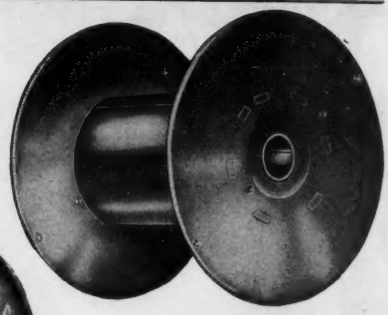

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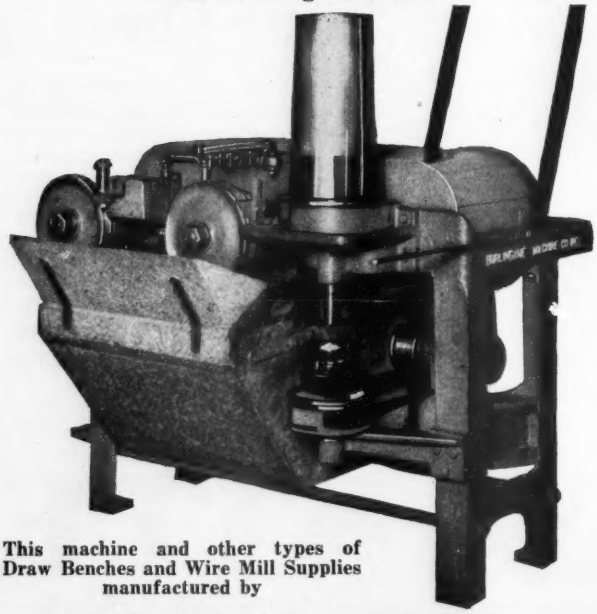

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suffice to give just a brief abstract of them as they agree pretty closely with the discoveries and observations set forth under A.

It is not the purpose of this monograph to treat the static and dynamic strain that is brought to bear upon the rope by torsion, flexure and rotation. We are concerned with the classification and computation of experiences that pertain to depreciation in general as it occurs in consequence of local pressure between the wires and the pulley, the edge of the pulley and the rollers, and the contact of two rotating wires. According to the observations of the Stuttgart Laboratories, which experimented along these lines for more than three decades, the damages on the surface of the wires are the deciding factors which limit the life of the rope, other influences merely taking a secondary position. These "surface-influences" are the more remarkable as they do not result from "motionless contact" but from reciprocal "rubbing" and "squeezing" as well as from high pressure. The rope sometimes swings so vigorously between two poles that surface damaging knocks become inevitable. It may safely be said that rope deteriorations in consequence of "rubbing" and "squeezing" not only does depend upon structure and condition of the rope but also upon the arrangement and the construction of pulleys, reels, and drums. The lubricant, too, plays a very important part. The so called "surface-influences" are much more pronounced if the rope consists of thin wire as compared with wire of larger diameter.

It should be remembered, however, that there are still other factors which may accelerate the depreciation of the rope. It may suffice to mention in this connection air, moisture, acid containing waters, dust, mud, etc. These influences sometimes prove fatal. They tend toward diminishing of the cross section, damage the surface, lower the tenacity of the wire,

and sometimes eliminate the beneficial effects of the lubricant.

The tension, so to say, encased in the rope in the process of manufacture, too, is of vital significance. It sometimes adds to the strain resulting from the actual operation of the rope, at other occasions, however, it counterbalances this very strain. It follows from this observation, that: not all individual wires participate equally in the power transfer, and that the individual wires tend to move within the strands, and the strands in turn move within the rope. This "internal-motion" loosens the wires in the strands and the strands in the ropes, and often results in protrusion of certain parts of the structural unit. This deformation of the rope structure admits atmospheric elements and other fatal substances. Excessive protrusions, however, occur rather seldom in connection with round worked rope as such ropes as well as their parts are manufactured with great care. It should be noted, however, that the protrusion-tendency can not be fully eliminated as it is impossible to keep the tension of the rope and its parts even and well balanced while they are in the manufacturing process. It should be emphasized that even the slightest protusions expose the thus affected wires to extraordinary squeezing and its ill after effects, such as lowered tensile strength, etc.

A new corporation is being formed under the name of the General Cable Corp. This corporation will be a merger of several of the largest cable companies, the Safety Cable Co., Standard Underground Co. and the sheet rod and wire mills of the Baltimore Copper Smelting and Rolling Co. This merger has received the approval of the directorates of these companies and only awaits the favorable vote of the stockholders.

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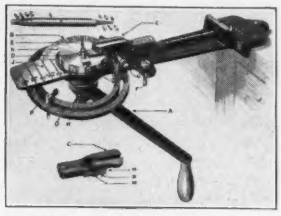

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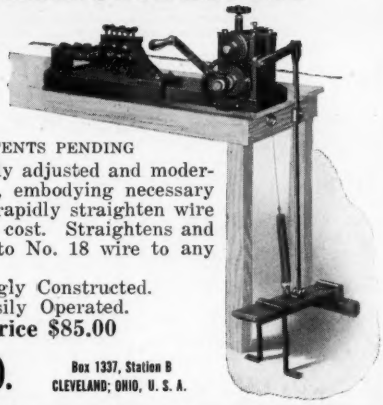

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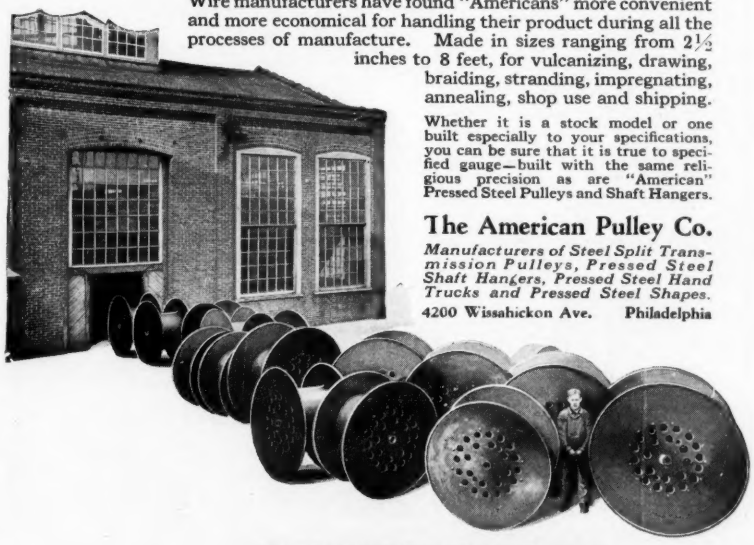

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New British Specification For Hoisting Ropes

(*Continued from page* 14)

the rope and unstranded. The wires shall then be well mixed together and not less than 24 wires from any one rope, or the number of wires in one strand, whichever is greater, shall be taken by the purchaser or his representative and tested as follows:—

A. One-third by the torsion test.

B. One-third by the tensile test.

C. One-third for the repeat test in case of failure.

Test samples taken in this manner have to withstand without breaking or showing signs of splitting or other defect, not less than the number or the equivalent of the number of torsions laid down in table 4, for the diameter and class of wire used when tested by the torsion test prescribed. The length of wire used in the test shall be agreed upon between the purchaser and manufacturer.

Test samples must show a tensile strength of not less than the minimum figure given in the table of breaking strengths for the diameter and type of wire used when subjected to the torsion test. If more than one wire falls below the standards for torsion tests or tensile strength laid down above, the further set of a third of the wires taken for testing shall be tested in the manner in which failure occurs, and if from the further number of wires tested more than one fails, the rope represented by the sample shall be liable to rejection.

In the event of a rope being rejected, the manufacturer is at liberty to have independent tests carried out by a testing authority to be agreed between the purchaser and the manufacturer, and if such tests comply with this specification the rope shall be accepted. Such independent tests shall be carried out in accordance with the provisions of the B. E. S. A. specification.

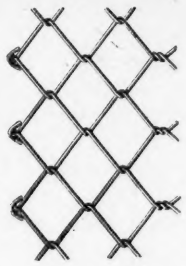
The breaking load must be not more than 5 per cent below that given in the tables for the size and construction of the rope and for the quality of the material used in its manufacture. If the purchaser requires that the rope be tested to destruction, it must be stated in the inquiry, and the manufacturer may have this operation carried out at a public proving house. The manufacturer must give the purchaser all reasonable facilities to satisfy himself that the wire and rope are in accordance with his specification. All tests and inspections must be made at the place of manufacture of the rope, and prior to despatch, unless otherwise specified by the purchaser, and shall be so conducted as not to interfere unnecessarily with the manufacturer's works.

The rope must be suitably protected to avoid damage in transit, and shall be supplied in a coil unless specified on a reel by the purchaser. A metal tag, unless otherwise specified, must be securely attached to each coil or reel, and must be stamped with the manufacturer's name, date of supply, grade of the material, the circumference, weight, breaking strength, and length of rope. Finally, the manufacturer must furnish the purchaser with a certificate that the rope complies with the B. E. S. A. specification.

The following information must be furnished by the purchaser to the manufacturer:

1. Details of Shaft.

(a) Depth from lowest working level in shaft to bank and a vertical distance from bank to center of pulley in headgear.



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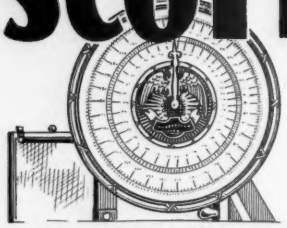

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(c) Whether wet or dry, and approximate range of temperature variation.

(d) Whether shaft water is known to be of an injurious nature, and if so an analysis of the water.

(e) Whether steam is exhausted into the shaft, and whether there are any other special circumstances likely to affect the rope.

2. Particulars of drum, reel, or pulley of winding engine and headgear pulleys.

(a) Type of drum.

(i) If parallel type, give diameter and width, and distance of first working turn from center line of drum.

(ii) If conical type, give maximum and minimum diameters and distance of first working turn from center line of drum.

(iii) If cylindro-conical type, give maximum and minimum diameters, distance of first working turn from center line of drum and number of turns on the scroll. Also give width of parallel portion of drum, and width of lowest portion of scroll.

(b) Nature and arrangement of drum lagging or cleading material.

(c) Whether rope is wound on itself, i. e., in more than one lap, and if so, number of layers.

(d) Diameter of pithead pulley at bottom of groove.

(e) Distance between centers of pulleys and whether the vertical center line between the pulleys coincides with the center line of the drum.

(f) Heights of centers of pulleys above center of winding drum.

(g) Horizontal distance of drum center from rope hanging in shaft.

3. Maximum rope speed in feet per second.

4. Time of acceleration of drum of winding engine.

5. Maximum working load, exclusive of rope.

6. Particulars of rope desired.

(a) Length.

(b) Lay, Lang's or Ordinary, right hand or left hand.

(c) Diameter.

(d) Construction, and grade of material.

(e) Whether galvanized or otherwise externally protected by metal.

(f) Nature of main or central core.

(g) Particulars of inspection and testing required.

7. Whether to be delivered on reels or in coils.

The manufacturer must supply the following data to his customer:—

1. Quality of material and description of wire.
2. Circumference or approximate diameter of rope.
3. Details of construction—

(a) Number of wires per strand.

(b) Number of strands.

4. Nominal size of wires.
5. Nature of material of center core.
6. Nominal weight in pounds per fathom (6 feet) of rope.
7. Average tensile strength in tons per square inch of wire (to be stated for each grade of wire used).
8. Guaranteed minimum breaking load of completed rope, in long tons.
9. Gross weight of rope, as packed for transit.
10. Maker's certificate.

The copper sulphate test for galvanized wires calls for a single wire about a foot in length to be dipped in wood alcohol and wiped dry. The wire must then be dropped into a freshly made neutral saturated solution of copper sulphate specific gravity 1.175) at about 60° F. (15.6C.) for the length of time specified below. It shall then be removed and wiped clean and the process be repeated. The duration of each immersion in the copper sulphate and the number of immersions shall be as follows:—

At the conclusion of this test the wire must show no sign of a deposit of bright metallic copper which will not easily wipe off. Not more than three samples of wire are to be immersed in the solution at the same time.

The circumference of a wire

rope must be measured at three places at least five feet apart, with a suitable device, such as a rope caliper. The average of these measurements shall be the circumference of the rope.

After being unstranded, the wire must be carefully straightened before being torsioned. Care must be taken that the straightening does not damage the wire. The test sample must be gripped in two vices, one of which shall be free to move longitudinally, and the wire shall be twisted by one or both of the vices being made to revolve. The number of twists shall be indicated by means of a torsion counter and the full number of twists shall be visible between the vices.

For the tensile test a testing machine must be used, the action of which can be readily checked and the machine adjusted, if necessary. The machine must be subject to the approval of the purchaser (or where it is the property of the purchaser, to the approval of the manufacturer), who shall be afforded all necessary facilities for proving its correctness. The test sample of wire as cut from the rope must be placed in the machine without being straightened or prepared in any way before testing. Nine-tenths of the minimum breaking load shall be applied quickly and the load shall then be increased steadily until the sample is broken. The time occupied in applying the remainder of the load shall be as nearly as possible 20 seconds, and the total time from the application of the load to the break shall be approximately 30 seconds.

Continuous and Automatic Gas Heat Treating

(*Continued from page 9*)

in operation, yet make it possible to reinforce and strengthen by drawing a steel band around the box, carton, crate or package and lock it with a pilfer proof seal while under extreme tension. No nails are used in the application, hence the name, Nailless Strapping.

There are two other machine shops for plant maintenance and for making of all dies, jigs, tools, etc., as well as the designing and building of all special machines used in both plants.

The Use of Breakdown Diamond Dies in Drawing Wire

(*Continued from page 7*)

out by the next die and after drawing down three or four more sizes, the defect on the wire will not be noticed. But, it is there just the same. And, the wire drawn through a cracked die affects the following die very badly, and in many cases, after a certain amount of work, it breaks the following die.

Another poor form of application of breakdown dies is noticeable when the die is allowed to over-run from .001 to .002 on a size between .032 and .036 or .036 to .040 where the next die is of the proper size. In this instance, instead of getting the usual 10% reduction, a draft of anywhere between 15 to 20% is actually made and causes, what is called, crowding of the die and thus greatly changes the slippage and creates bad wire.

It is therefore recommended that when dies are recut, they should really not only be pulled up to the next size, but be recut, reshaped, and repolished, by going through all the necessary operations as a new die. And when same is done, it can be used as a breakdown or a finishing die as well.

Secondly, it is recommended that only properly shaped and polished dies be used throughout the machine and that at certain particular intervals, all the dies in the machine be checked up and only those that have a standard draft in comparison with the next die, be allowed to run in the machine.

By following these three principles, a much better wire can be produced at a much smaller cost of the dies, with less trouble in running the machines.

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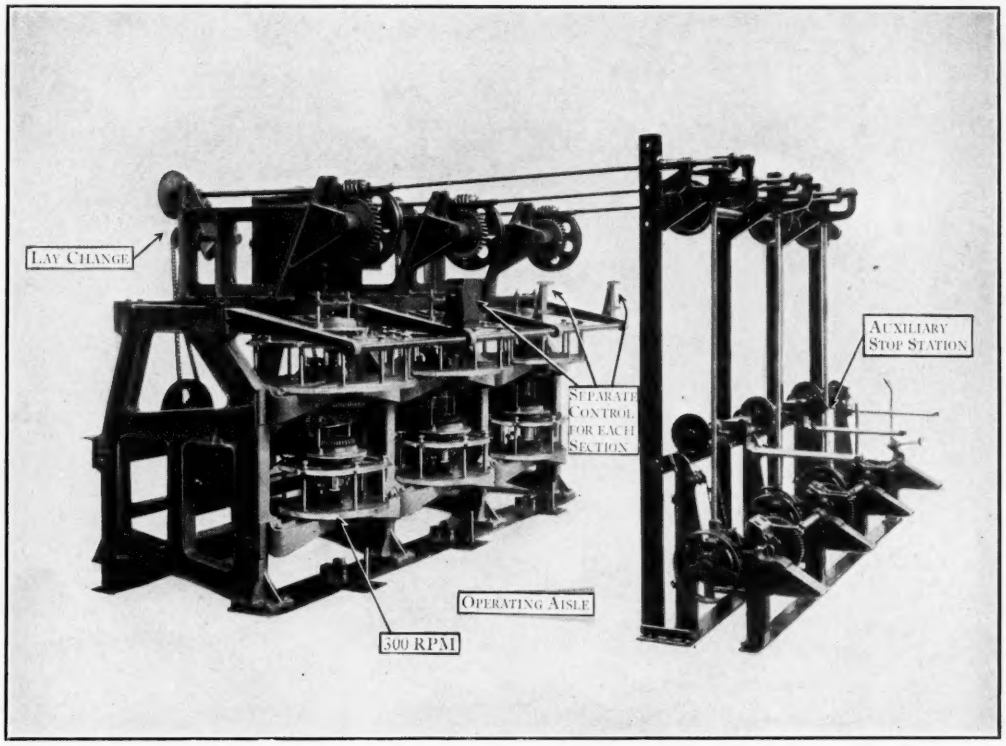

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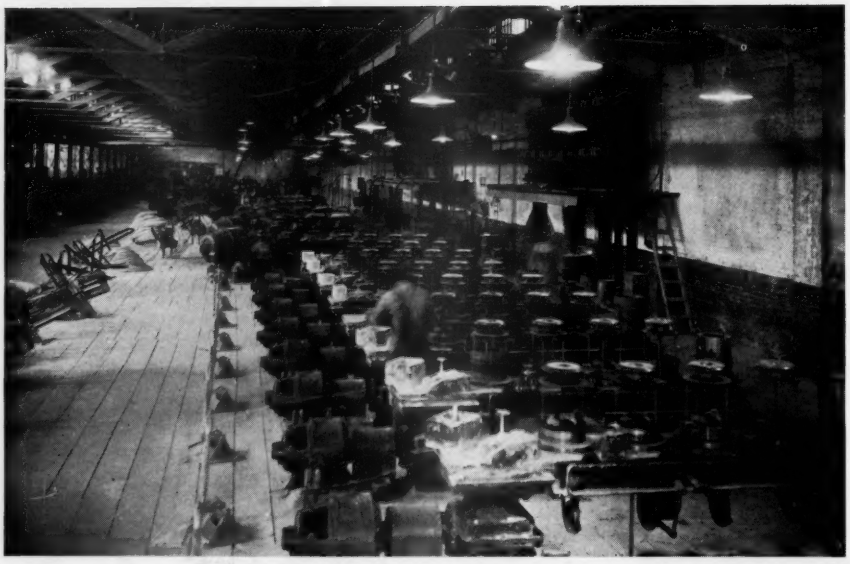

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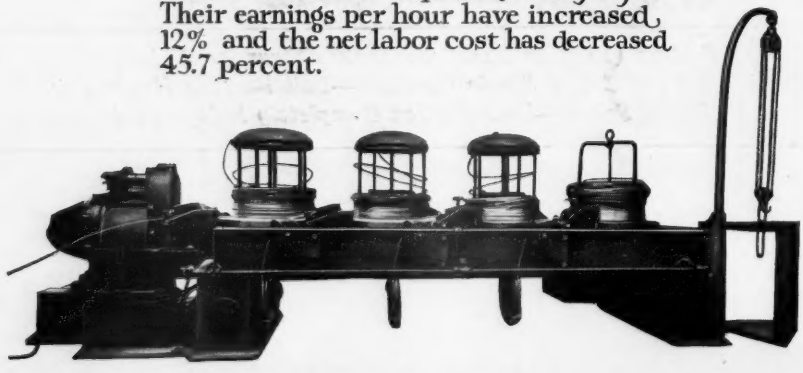

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